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Jim Bond - MA

How does the control of speed and time in contemporary kinetic sculpture dictate the narrative and form of the work?

Introduction

"Twentieth-century art may start with nothing, but it flourishes by virtue of its belief in itself, in the possibility of control over what seems essentially uncontrollable..." (Alvarez, 1971).¹

Control is central to my practice as a kinetic sculptor and distinguishes my work from static sculpture as well as the work of many kinetic sculptors. The aim of my enquiry is to examine this distinction and to explore the significance of the kinetic artist's ability to control time and speed. Creating structures which are able to alter and move within a predetermined period of time adds another dimension to the role of the sculptor and enables a unique interaction with the audience. I will argue that the ability to control the progression and development of a piece of work in time and space places kinetic sculpture between sculpture and performance. The artist is able to extend his role from the controller and manipulator of objects and space to the director or choreographer of an automated performance. Most sculptors create work which is intended to be viewed by an audience and sculptors therefore must have the audience in mind when creating a piece of work. Kinetic sculptors, unlike those working with almost any other material apart from light, are able to continue to alter the form of the work after it has left the studio and is actually on display. I will argue that this allows more influence over the way the sculpture is perceived by the viewer. It's this relationship between the artist, the work, and the audience which is central to this thesis. In order to examine these themes in depth I will break the subject down into the areas of 'Movement & Performance', 'Time' and 'Control' and will use at least one of my kinetic sculptures to illuminate each chapter, providing context by referencing existing and historical kinetic work.

To begin with it is important to establish the origins of the word 'kinetic' which is derived from the Greek word 'kinetikos' meaning "moving, putting in motion". The word came into common use when Lord Kelvin (1824–1927) coined the term kinetic energy and it was subsequently adopted and adapted to describe moving devices such as Thomas Edison's (1847–1931) 'kinetoscope' (1888).² The term kinetic has been applied to a broad range of artwork from optical painting and optical illusion sculpture by artists such as El Lissitzky (1890–1941) to physical three-dimensional sculptures which actually move such as Laszlo Moholy-Nagy's (1895–1946) 'Space Light Moderator' (1922–1930). Kinetic artists have employed numerous sources of power and ingenious mechanisms for creating kinetic movement in their work. Alexander Calder (1898–1976), for example, relied on wind and air currents to animate his mobiles and in 1913 Luigi Russoli created sound machines which had to be hand-cranked by the audience. In 1951 Bruno Munari used clockwork mechanisms for some of his smaller 'Useless Machines' and in 1959 Jean Tinguely (1925–1991) created 'Meta-matic No. 17' which was powered by a petrol engine. For the purposes of this thesis, however, I am primarily interested in sculpture which moves or alters its state using the universal source of controllable and programmable power, electricity. Cheap electric motors and the development of electronic control systems have enabled the creation of sculpture which can be made to move and respond. With these tools, time becomes another malleable material with which to work. The introduction of movement into sculpture opened up new possibilities

for creating work which instead of being 'set in stone' could change, develop and alter, a point made by Shanken (2009) in his essay *Survey*:

Art no longer stood still in space or time. Freed of frame and pedestal, animated by electricity, it could move about in the space of the viewer or the environment, modulate between various states or take on a new identity (Shanken, 2009, p.17).³

In chapter one, 'Movement & Performance', I will begin by defining movement in a broad historical context before examining the way movement is perceived and understood. The movement of kinetic sculpture ranges from the imperceptibly slow to rapidly oscillating forms. I will discuss how variations in speed can alter the way works perform and are perceived by the viewer.

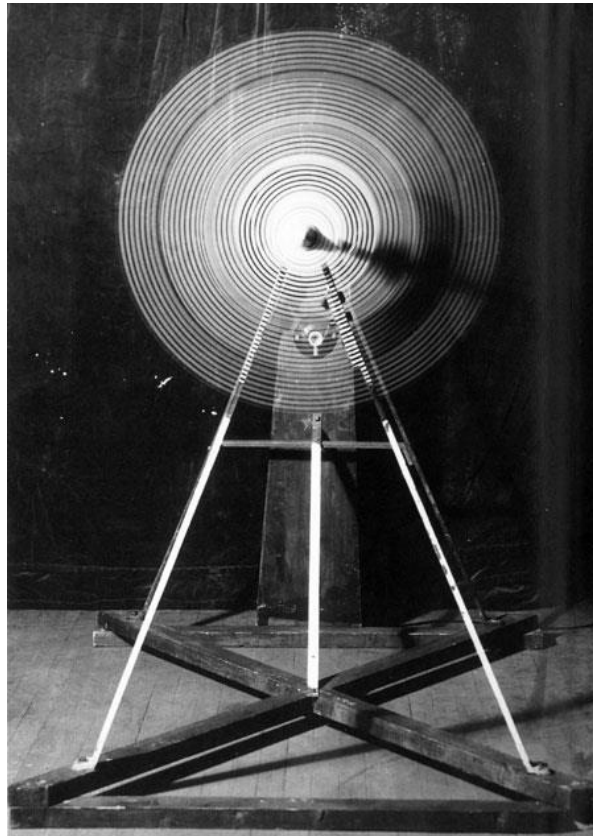
My observations will focus on my kinetic light installation 'Becoming Whole' (2013) which uses lenses and a distorted sculptural form to create two-dimensional figurative images with moving shadows. I will explain how my control of its movement is integral to the way it operates and is perceived.

The use of controlled movement creates the possibility of work which reveals the narrative to the viewer at a pace which is dictated by the artist. As such the work can be considered a kind of mechanised performance. At the end of the chapter I will examine a piece of work which is operated, controlled and timed by the artist in advance. William Kentridge's automated installation 'Black Box' exemplifies the potential for controlled movement to create a 'Theatrical' piece of work.

In the second chapter, 'Time', I will establish a basic understanding of time as a foundation for the exploration of time in the context of my own work. I will be looking at the way static and kinetic sculptures exist within time frames which are fundamentally different from each other. I will establish the principle that kinetic sculpture is a sequential series of happenings which take place within a clearly defined time period and compare and contrast this to both static sculpture and performance. My examination of the use of time in moving sculpture will draw on the experience of creating and exhibiting my kinetic sculpture 'Atomised' (2015) which assembles a wire figure in space for a programmed period of time before breaking it apart again. 'Atomised' expresses the temporal nature of life, visually describing the process by which we are formed, exist and then die.

The fragility of life and the depiction of life and death are not new to art. *Memento mori* such as the eighteenth-century wax *Vanitas* Tableau in The Wellcome Collection depicted figures which were half alive and half skeleton as a reminder to the living that we are all mortal and finite and that one day we will die. 'Atomised' which compresses a lifespan into a few minutes is distinctly different from these static sculptures because it employs time as a device to describe the length of a life. 'Atomised' takes a few short minutes to assemble, remain together, and then dissipate, expressing years in seconds. In this sculpture, time becomes one of the materials of the work. I will be looking at time in the specific context of control, developing the idea that the ability to programme kinetic work gives artists the ability to control the progression of the altering form of the work and the pace at which it happens. This allows the introduction of pauses and time periods which break up the narrative as it is experienced by the audience in real time.

The third chapter, 'Control', will explore the range of ways kinetic artists are able to control the speed and timing of their sculptures and installations. The ability to control motion within a passage of time is only possible in 'Time-based arts' which are defined by the website artlab33 (2012) as "... a cluster of units dealing with the complex multiplicity of artistic forms which use the passage of and the manipulation of time as the essential element" (Artlab).⁴ Time combined with altering shape and form in three dimensions gives kinetic sculpture a distinctive position in time-based art.



Man Ray, Marcel Duchamp, *Rotary Glass Plates*, 1920

There are levels of control which artists are able to exercise over materials. I will begin by discussing the sculptor's ability to shape and mould the material they work with using stone carving as an example. In order to set my work in a historical context I will investigate early kinetic sculpture as well as the clockwork mechanical works which preceded them. Sculptures such as Man Ray's 'Standing Wave' (1919) and Marcel Duchamp's 'Rotary Glass Plates' (1920), for example, were either on or off. Control was manual and the concept of an interaction with the audience was limited. Subsequent sculptors who began to exploit movement in their work were less concerned with control and precision and more interested in the immediacy and dynamism afforded them by movement. The early work of sculptors such as Jean Tinguely and Alexander Calder (1898–1976) lacked the refinement and sophisticated construction of the Automatists who preceded them and the accuracy of the commercial machines created by contemporary engineers. These were consciously crude and simple constructions. The artists were unconcerned with exact timing, preferring to allow the movement of their sculptures to be dictated by wind and chance elements. Calder was happy to admit that despite his training as an engineer his methods were simple. In his interview with Paul

Cummings (1971) he contrasted his intuitive approach to balancing his work with the methods used by the engineers and fabricators he later employed to create his larger works: "If you have an object and you want to find the center of gravity, they don't hang it up and draw a line, and hang it up again and draw another line, they calculate it (laughing)" (Calder, 1971).⁵

My own work makes use of programmable controllers which were designed for industry. Unlike Calder the direct control of my work is important to me. I do, however, allow random interventions in the form of proximity sensors which trigger the activation of the work when visitors are present. My work is a controlled experience which develops within a time frame. Interaction with the audience is an essential element of my practice and I will discuss the importance of being able to control the timing and movement of sculpture and sculptural installations making specific reference to my kinetic sculptures 'Eraser' (2014), its precursor, 'Dust' (2008), and 'Blink' (2008).

Sculpture and three-dimensional installations make specific demands on the viewer. In order to completely see a sculpture it is necessary to view it from several different perspectives. In this respect the viewer is in control of the experience. They choose the pace at which they walk, and the points where they would like to stop and look in more detail. There is a balance between the sculptor who has chosen the materials and form of the sculpture and the viewer who looks at it, enters its space and engages with it. A sculpture which moves itself presents new possibilities for those who interact with it. The sculptor is able to plan and implement mechanisms and time delays to create an impression on the viewer but the actions and perceptions of the viewer aren't always predictable. Their role may become more passive as they remain still and observe the sculpture perform or more involved as they engage with a responsive or interactive sculpture which requires their participation. Nam Jun Paik's interactive sound installations such as 'Random Access' (1963), for example, required the audience to make choices, edit and assemble sounds. In this way they are given an element of control of the production of the exhibited work. Moving work needs a trigger to begin the release of energy and power. There are numerous ways in which this can be done which affect the frequency and duration of the movement. I will explore some of the more unusual and creative ways artists have activated their work, highlighting the degree of control which is being exerted by the artist.

Moving sculpture is by definition only complete when it is able to move. Kinetic sculptors usually build their work to perform reliably but there are times when like all machines they cease to function. The nature of artist-made machines is that there is always the possibility of another agenda. Industry, for example, would never create a machine such as Jean Tinguely's 'Homage to New York' (1960) which was designed to self-destruct. There is also the question of intent. When Chris Burden designed 'When Robots Rule: The Two Minute Airplane Factory' (1999), for example, did he deliberately create a machine which was never intended to work? If this was the artist's intention then the notion of breakdown as a loss of control is inverted as the artist exploits the audience's notions of what a machine is for and how it should behave. I will examine in more detail the development of the methods and processes by which artists create and then control moving sculpture and consider how this control over the work influences the narrative within it and the relationship between the artist and the audience.

Chapter One – Movement & Performance

"Movement, is the property of evolving and developing, is the basic condition of matter. This exists in movement and in no other way. Its development is eternal" (Fontana, 1948).¹

When kinetic movement was introduced into contemporary art by Alexander Calder and Naum Gabo (1890–1977), movement itself, combined with form and structure became the central element of the work. As Shanken (2009) states: "Defying the traditional conception of art as a static object, in the early twentieth century, artists began to introduce actual motion into their work, making explicit the continuity of consciousness in the perception of art through time and space" (Shanken, 2009, p. 55).²



Marcel Duchamp, *Bicycle Wheel*, 1913

Marcel Duchamp (1887–1968) described the simple appeal of his iconic sculpture 'Bicycle Wheel' in the following way:

An ordinary wheel. A bicycle wheel in a stand. I would turn it as I passed by. The movement of it was like a fire in a fireplace. It had that attraction of something moving in the room while you think about something else (Furlong, 2010, p.17).³

This fascination with movement and the way movement catches our eye and our attention can be a powerful urge. In 'Art and Visual Perception' Rudolph Arnheim suggests that this has developed from the basic instincts of human survival.

It is understandable that a strong and automatic response to motion should have developed in animal and man. Motion implies a change in the condition of the environment and change may require reaction. It may mean the approach of danger, the appearance of a friend or of desirable prey (Arnheim, 1954, p.372).⁴

It's this change in condition from static to moving which triggers the 'attraction' which Duchamp refers to, and explains our fascination with moving sculpture. Duchamp was quick to highlight the problems of defining what movement actually is when discussing Bachelard's descriptions of movement with his friend Denis de Rougement: "What does he call movement, your fellow? If he defines it in opposition to rest that doesn't work, because nothing is at rest in the universe" (de Rougement, 1969).⁵

Duchamp was expressing his grasp of the findings of the French philosopher Rene Descartes (1596–1650) who described all objects and space as in motion. He wrote that movement is "... simply the transfer of one body from the vicinity of other bodies which are in immediate contact with it" (Descartes & Cottingham, 1985, p.252).⁶

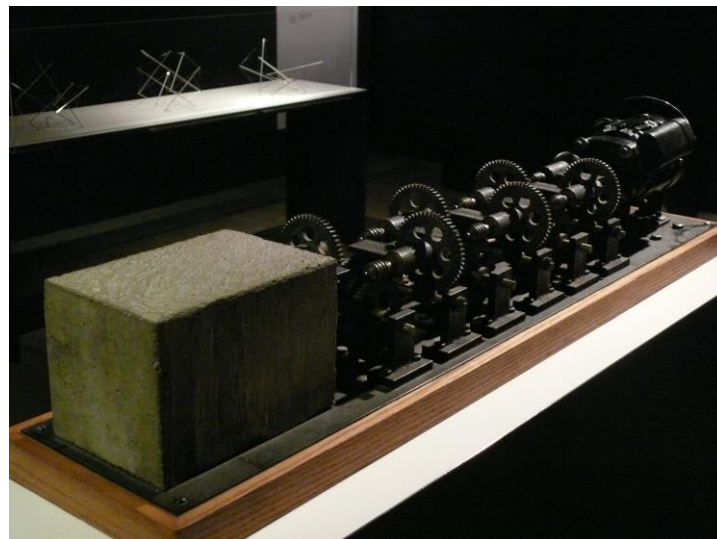
In terms of the perception of movement and the difference between moving objects the German philosopher and astronomer Nicolaus Cusanus (1401–64) recognised that we can only see movement if one object moves in relation to another: "We can recognise movement ... only by comparison with something stable, such as poles or centres, the relation to which we presuppose in our measurements of motion" (Arnheim, 1969, p.288).⁷ There are within this definition a vast range of types of movement varying in speed and duration. It is the difference in the speed of objects that allows us to perceive movement. In *Art, Time and Technology* Charlie Gere succinctly explains this idea that speed is the quality which defines one movement from another, and distinguishes the visible from the imperceptible.

Speed does not mean simply the action quality or capability of moving quickly or rapidly – it means simply, rate of progress or motion. In that everything, even things which are ostensibly not moving, has a rate of progress, and that an object's speed can only be perceived in relation to that of other objects, speed is pure difference. Only through the perception of different rates of movement can we apprehend time and by extension, space. (Gere, 2006, p.22).⁸

Movement is perceptible when objects increase or decrease their distance from each other but also when objects change position in relation to the viewer. The ability of the viewer to analyse and understand the movement they are seeing requires a calculation of space and perception of constantly changing distance. Our experience of movement is primarily perceived through our eyes. As Paul Virilio points out in his essay *The Museum of The Sun*: "The human eye is a powerful instrument for the analysis of visual structures, capable of determining the optical depth of events very fast (20 milliseconds)" (Virilio, 1997).⁹ For all its sophistication the eye is not able to detect the vast spectrum of speeds of movement happening around us, focussing instead on a

limited and very specific range. As Rudolph Arnheim states there is an important evolutionary reason for this: "It is biologically essential that we see people and animals move from one place to another; we do not need to see the grass grow" (Arnheim, 1954, p.384).¹⁰

Not all kinetic art is restricted to movement that is within the range perceptible by the human eye. At one extreme end of the spectrum of movement in kinetic sculpture are machines which move at speeds which are so slow that they are imperceptible. Chris Burden's installation 'Samson', for example, which was installed in Zwirner and Wirth in 1985, moved a hydraulic jack a fraction wider every time a visitor entered the gallery. The jack was pushing the gallery walls apart so that the success of the exhibition had the potential of destroying the gallery. Although the hydraulic rams which pushed the walls apart were moving a fraction at a time, and were impossible to detect with the naked eye, the turnstile was a visible kinetic lever which the audience had to push through and they were therefore aware of the consequences of their actions.



Arthur Ganson, *Machine with Concrete*, 1998

More visible in its progression into imperceptible movement, and even slower than Chris Burden's jack is Arthur Ganson's 'Machine with Concrete' (1998) which consists of a motor driving a series of worm gears, each one reducing the speed of the next until the final gear which is so slow that it is embedded in a block of concrete. It is turning but at a speed of one revolution every 13.7 million years. The motor driving the machine spins and turns the cogs and gradually the cogs become slower and slower until they appear to stop. Again the viewer is unable to see the movement but they are aware that the slow cogs are moving because they can follow the visual clues and they understand the principle of gears reducing speed.



Naum Gabo, *Standing Wave*, 1919

At the other end of the scale, rapid movement and oscillation have a profound effect on an object and the way it's viewed. Naum Gabo's 'Standing Wave', also titled 'Virtual Kinetic Volume' (1919), for example, used an oscillating wire to create a visible wave form. The application of energy alters both the form and the perception of the sculpture as the wire moves so fast that the eye sees it in two places at once, transforming its physical form as well as its appearance. Gabo's wave has two states, it's either on and its kinetic vibration creates the appearance of a vertical wave or it's off and it reverts back to being a piece of wire. The sculpture as it is intended to be viewed is wire plus energy and without the energy and movement it is incomplete, a thin vertical wire.

In the Introduction to his book *The Origins and Development of Kinetic Art* (1968) Frank Popper separates movement and the perception of movement, with reference to kinetic sculpture, into distinctly separate categories.

First of all we have the element of movement in the work: this element that can be perceived could be called the 'image' of movement in the widest sense...Then there is the movement of the artists hand, and of his whole body; the way in which these are involved closely affects the genesis of the work, and perhaps even its structure. Thirdly there are the eye movements of the spectator himself, as in the case of a walk around a sculpture or within an architectural monument (Popper, 1968, p.7).¹¹



Jim Bond, *Becoming Whole*, 2013

These three definitions can be applied to my kinetic light installation 'Becoming Whole' which uses movement to create a visual illusion. The origin of this piece is the phenomenon of 'The Brockham Spectre', a rare optical illusion observed on the Cairngorm Mountains in which a person's own shadow is projected onto low cloud and perceived as a spectral figure. 'Becoming Whole' is a puzzle which slowly unfolds before the viewer, a natural progression of my kinetic body-related pieces such as 'Atomised'. The motor rotates slowly, decelerating to pause before accelerating again. The movement is driven by a stepper motor which travels in small increments of rotation, each one triggered by a pulse. The sequence and frequency of the pulses are programmed and then stored in an Arduino micro controller, a small and relatively cheap piece of circuitry designed by Italian engineers in 2005. The Arduino allows me to control the pace of rotation and build in the points at which the sculpture pauses and waits before moving off again. It is of course possible to control speed, deceleration and pauses using cogs and gearing but the construction would be long and laborious and, critically, there would be no flexibility to change it once it was built. The electronic control of electric motors, actuators and electromagnets opens up opportunities for flexible creativity and intuitive construction. The shadow projection of 'Becoming Whole' moves slowly across a 3-metre wide by 2.2-metre high back-projection screen. The shadow is created by a distorted wire structure which is rotated in front of a projector. For most of the 360 degree cycle the shadow created is a random network of moving lines created as the wire structure's position changes relative to the light source. There is one point at which all the wires line up to create the shadow of a figure. At this point the movement stops and the shadow figure remains visible for a brief period before the movement resumes. The structure rotates and the transient figure disappears back into chaos. The figure remains hidden until this key point. The movement creates the dramatic progression from moving shadows to an image which makes sense. The underlying narrative of the work describes a figure being created and then disassembled. The moment of completeness is temporary and transient. The shadow is revealed by being projected onto a screen and the narrative unfolds like a short film.



Jim Bond, *Becoming Whole*, Crossley Gallery, 2014

Unlike much of my other kinetic work 'Becoming Whole' doesn't respond or interact but runs constantly, rotating and pausing at two key points in a continual unchanging performance with no beginning and no end. The shadow of a tiny wire figure passes across the screen upside down, suspended and helpless, unable to prevent the ultimate destination of his orbit. The machine which drives the rotation pauses and the figure's shadow is brought sharply into focus by a lens. The latent energy of the motion still present within the wire causes the figure to oscillate and vibrate uncertainly. The small figure represents a view of the past projected into the future. His shadow is simplistic and unclear, an estimation lacking in detail. He is in the liminal state between confusion and clarity. The motor restarts and the arm continues on its rotation leading to its inevitable next phase. A distorted jumble of wire drags its confused network of shadows across the wall slowly, taking shape as the machine draws with light and dark, pulling the pieces together. When the arm pauses again the large figure is assembled and complete, formed from the wreckage of wire. Time waits for no man and so it is the case for the shadow figure which moves off again, visually unravelling as it disappears back into the shadows. 'Becoming Whole' graphically demonstrates the transition from one state to another. There must be movement in order to describe the transition.

In terms of Popper's definitions, the first element 'movement' encompasses several different types of motion. The two most prominent ones, the rotating steel wire structure and the moving projected two-dimensional shadow across the screen are created by the physical interruption of the projected light. Then there is the moving projection of a figure of light created by a mirror on the rotating structure which moves around the walls of the installation. Finally there is the vibration created by the inertia of the small wire figure which is only visible because the image of it is magnified through a lens and projected. His second definition refers to the hand of the artist. During construction there is the making process as the wire structure is welded into position by lining up the shadows it creates. The turntable is built and supported by an aluminium framework and a projector is added. The final stage of the creative process is to wire up and programme the electronics which provide the control and allows spaces and pauses to punctuate the movement. All this work is visible and evident in the construction of the work. The final element is the movement of the eye of the viewer. The shadow projections can be

viewed from one static position but the concept of the piece is that the secret of the shadow is revealed when the viewer moves and casts their gaze beyond the screen. Until the viewer sees beyond it, the source of the shadow is a mystery and the projection can easily be mistaken for an animation. The projector and the rotating objects create a constantly changing pattern of images. Victor Vasarely, an early exponent of two-dimensional kinetic art wrote in his *Yellow Manifesto* of 1955: "The screen is a plane surface; yet allows movement; it is also space" (Vasarely, 1955).¹² For Vasarely the screen defined a flat clear area onto which movement and action could be projected. In 'Becoming Whole' the screen creates the same flat receptive space onto which the moving image can be projected but in addition to this there is an added third dimension. The rotating wire form behind the screen is what turns it from a moving two-dimensional image into a three-dimensional and sculptural installation.

There is a strong connection between kinetic art, performance and cinema. 'Becoming whole' employs elements of both performance and cinema. There is an element of performance in the way that this work unfolds and reveals the secret of its hidden figurative shadow. The pause in the performance is critical to the unfolding of the narrative and it's the transition from movement to static which gives it its dramatic poignancy. This is a tried and tested dramatic technique which has been used most notably in Japanese Kabuki theatre where the actors freeze in a dramatic pose. As Arnheim notes:

"An actor's play suddenly petrifies into an immobile, monumental pose, the *mi-e*, which marks the climax of an important scene and epitomizes its character" (Arnheim, 1969, p.182).¹³

These pauses and stopping points must be carefully planned and stored in the Arduino. The programming of a kinetic sculpture or installation can be seen as a form of choreography; indeed, the kinetic sculptor Arthur Ganson describes himself as a cross between a mechanical engineer and a choreographer. The South African artist William Kentridge employs some of the same optical tricks as 'Becoming Whole' using mechanised shadow puppets and back projection screens in his sculptural installation 'Black Box / Chambre Noire' which was commissioned by the Solomon R Guggenheim Foundation in 2005. With a background in theatre and acting, Kentridge has an understanding of gestural movement and timing, and having collaborated with Handspring Puppet Company Kentridge is well aware of the moving shadow as a narrative tool.



The shadow's ability to transform itself is one of the key qualities for understanding it. When one sees a shadow, one ascribes to it the characteristics of a kind of solid object. One imagines it has dimensionality, when in fact, the essence of shadows is lack of dimension (Kentridge, 2005, p.49).¹⁴

In order to make the sculpture work automatically he employed the skills of Jonas Lundqvist of the Swedish model making company, FAC. The sculpture consists of a scale model of a theatre stage 3.6 metres tall by 2 metres wide. Within the structure are layers of screens and automated shadow puppets which perform in sequence. Kentridge built it after having worked on the full-scale operatic production 'Learning the Flute'. He describes returning to his studio to work on a more manageable project as a relief and it's clear that work on a smaller scale allows him to regain a degree of control which he felt he had lost.

After the production was finished I wanted to go back to the miniature scale of the model – to get away from the craziness of the full scale production, with its many singers, musicians, technicians, and administrators, all of whom had their own needs and pressures, and return to the calm of the studio (Kentridge, 2009, p.171).¹⁵

Although Kentridge used Lundqvist to realise the kinetic elements of the work he was still much more in control of his mechanised performance than when he relied on actors and singers to perform the work. A mechanised set becomes a smaller world in which the characters appear on time as regular as clockwork. This use of mechanised performers to narrate his story does raise the question of the role of the machine in the development of the narrative.

Kentridge's insertion of the automata into *Black Box* problematizes this notion of movement untroubled by human action and fallibility, for although the hand of the creator per se is not visible, the mechanisms that allow the automata to function are. The automata in *Black Box* come into play and unsettle clear notions of agency" (Villasenor, 2005, p.87).¹⁶

Here Maria-Christina Villasenor touches on Popper's second definition of movement in kinetic art, that of the hand of the artist. The machine presents the story to the audience as a live performance with all the visible actions and movements constructed, choreographed and programmed by the unseen hand of the artist and technician. The machine becomes the performer and the artist the director. The movement of the artist

is evident in the case of 'Black Box' in the drawn marks of the figures but also in the planning and preparation of the motorised elements, the arrangement of the timing of the action and the ordering of the sequence of sound and light.

In terms of Popper's third definition of movement, "...the eye movements of the spectator", 'Black Box' and 'Becoming Whole' share a similar relationship to the audience. The action unfolds before them, allowing them to be passive, but kinetic installations such as this are more than just screens with projections. The conventional notions of cinema, theatre and puppet show are confused by the realisation that the work should be viewed as a whole and not just from one direction.

Is the black box constituted by the unmooring of the spectator from his typically fixed position in theatre and cinema? In the black box, the viewer becomes an ambulatory spectator, unsure how to take it all in, how to select the proper vantage point(s) to construct and deconstruct the spectacle as it unfolds and subsequently reveals itself (Villasenor, 2005, p.81).¹⁷

Kentridge allows the audience to actively engage with 'Black Box', wandering around the structure to view the mechanisms. Although the work would be understood if it was viewed from the traditional view of the theatre audience it is part of the audience's intended relationship with the work that they engage with it in a spatial context, exploring it from different viewpoints

By contrast, to fully understand 'Becoming Whole' the audience must go beyond and behind the screen in order to unlock the secret. The three elements of movement categorised by Popper are evident in 'Becoming Whole'. The movement of the work and the layout of the screen in relationship to the moving structure, encourage the audience to move past the screen to see the sculptural element and the origin of the moving shadow.

Chapter Two – Time

The Greek philosopher Aristotle (384–322 BC) said that: “Not only do we measure change by time, but time by change, because they are defined by one another” (Csikszentmihalyi, 2006, p.125).¹ He saw that time, like speed and movement, only exists as a measurement of change. The rotation of the hands of the clock and the orbit of the earth in relation to the stars are physically describing time by their movement. Sir Isaac Newton (1642–1727), however, believed that there is one true time which continues regardless of the movement of the universe and exists independently of it. He first introduced his theory of time, now called ‘Newtonian Time’ or ‘Absolute Time and Space’ in the *Philosophiæ Naturalis Principia Mathematica* (1687). Newton himself stated: “Absolute, true, and mathematical time, of itself, and from its own nature, flows equably without relation to anything external, and by another name is called duration” (Rynasiewicz, 2014).²

His theory was challenged by the German mathematician Gottfried Wilhelm Leibniz (1646–1716) who argued that time is intrinsically part of the universe and only exists as a measure of physical change. Leibniz’s view of time became known as ‘Relationalism’, and regarded everything in the universe as being interconnected. In 1905, Albert Einstein (1879–1955) published his ‘Theory of Special Relativity’ which stated that the speed of light always remained constant. This theory has become the standard against which speed and time is now measured.

In the Art World controversial theories of time can be stated without troubling Mathematicians and Physicists. Naum Gabo, as well as being the creator of one of the first and most important works of kinetic art, ‘Virtual Kinetic Volume’ or ‘Standing Wave’, was also one of the first to recognise the importance of time in the realisation and perception of his work. In 1920 Gabo, together with his brother, Nikolaus Pevsner, who would become a renowned Architectural theorist, wrote *The Realist Manifesto* in which they made the following statement: “In place of static rhythms in the plastic arts ... we announce the existence of a new element, kinetic rhythm, which is to be the basis of a new perception of real time” (Gabo, 1920).³

Gabo’s ‘Standing Wave’ is a perfect example of this ambition, with its physical vibration allowing the flexible wire to occupy space in such a way that it creates the illusion of a new form which is not concrete but exists as a consequence of the wire appearing to be present in many places at the same time. The illusion is created when the image remains momentarily on the retina, a phenomenon known as *persistence of vision* which was discovered by P.M. Roget in 1824. The eye is therefore capturing these increments of movement of the wire and placing them together as if they were all present at the same time.

Laszlo Moholy-Nagy was one of the first artists to see the introduction of time into an artwork as a critical additional element and described kinetic movement in his work in the following way: “... the volume relationships are virtual ones, i.e. resulting mainly from the actual movement of the contours, rings, rods, and other objects...To the three dimensions of volume, a fourth – movement – (in other words, *time* is added)” (Moholy-Nagy, 1928, p.47).⁴

Perceptible changes in form and structure over a period of time are what separate performance, music and film from the static arts such as painting and sculpture.

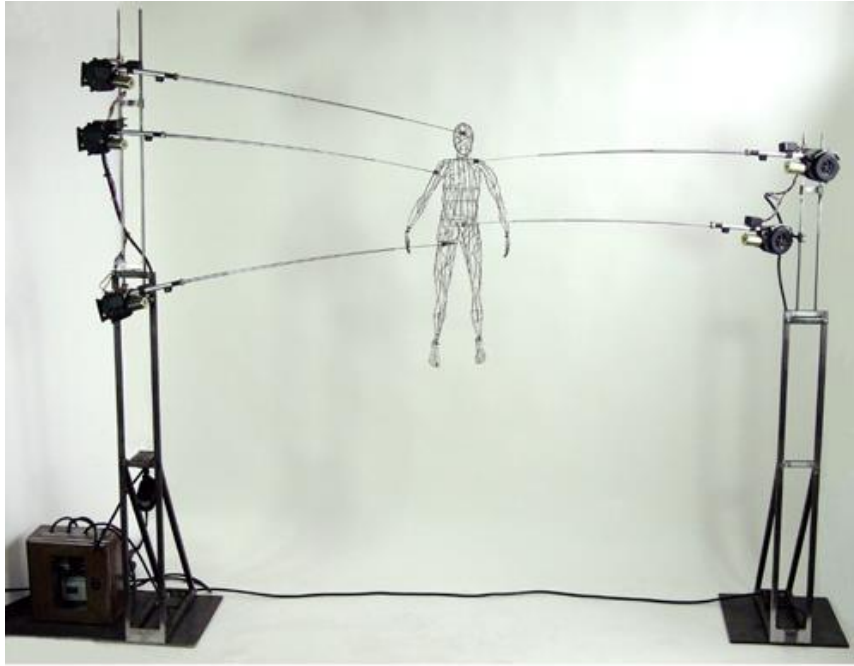
All sculpture exists within a time frame. The Scottish artist Aeneas Wilder, for example, builds structures by stacking small pieces of oak to create fragile temporary structures which exist for a predetermined period of time agreed between the artist and the gallery. On the final day of the work's existence the structure is 'Kicked down' by the artist in front of an audience and reverts back to the thousand pieces of oak which will be packed up and assembled somewhere else as a new sculpture. Rachel Carstens, a Creative Writing student who witnessed the 'Kickdown' of Wilder's work at the University of Maryland in 2012, wrote:

With a kick Aeneas Wilder's sculptural installation '#156', nearly two stories tall, collapses in a loud, eerie descent. It is as if in the moment of collapse we are interacting with the death of a thing, but it's just atoms shifting place" (Carstens, 2012).⁵



Aeneas Wilder, *Untitled #135*, 2007

My kinetic sculpture 'Atomised' has at its core the same underlying narrative. The work involves the construction of a figure from a series of disparate parts which come together for a set period of time before returning to the state of component parts. In theoretical physics there is a concept known as 'Time Reflection Symmetry' which states that any physical situation should be reversible in time. The narrative of 'Atomised' corresponds to this theory as a figure is assembled and then the process is reversed. The inspiration for this sculpture was the same realisation that everything is created by the shifting around of atoms. We are made by the coming together of atoms and as such, our bodies are a temporary and finite construction and when we die the atoms disperse and become something else. 'Atomised' is therefore about the passing of time, the portrayal of a lifetime.



Jim Bond, *Atomised*, 2005

'Atomised' consists of a figure divided up into five sections, each one attached to a motorised aerial and supported on two steel structures three metres apart. When a viewer approaches the sculpture the motors begin to construct the figure in the space between the two steel structures. The figure is assembled and suspended in space for a programmed period of time before it is deconstructed again. This is the creation of life and death compressed and expressed in a few minutes. The whole sculpture including its framework and controls exists as a physical sculpture and as such has a lifespan of years. The mechanism, when activated, constructs a figurative sculpture which is temporary and lasts for a few minutes. These two time frames exist one within the other and express the difference between our experience of time as it happens and how we view time over an extended period of years. Heidegger described our understanding of time as a succession of experiences and "in this succession of experiences only the experience that is objectively present 'in the actual now' is 'really' 'real'. The experiences past and just coming, on the other hand, are no longer or not yet 'real'" (Heidegger, 1996, p.342).⁶ In this way 'Atomised' the structure represents the past and the continuity of time and the moving performance of the motorised construction is experienced in the present as it is happening in "the actual now".

Klee said that "to define the present in isolation is to kill it" (Klee, 1961).⁷ Sculpture has a past history, a present experience and a future. In their writings on the Lascaux cave paintings George Bataille and his co-author Stuart Kendall describe how the creation of art and tools allowed early humans to begin to order time in this way and suggests that this was how they began to perceive time, anticipate the future, and understand the past.

Only through working stone did man make an absolute break with the animal. What caused this scission was the exclusively human *thinking* work demands. Work anticipates, presupposes the object that does not yet really exist, which is presently

being made, and which is, simply, the reason the work is being done. Two sorts of objects immediately come into existence in the workers mind: actually present objects and objects later to come. This already dual aspect is completed by the object of the past, therewith, all the gradations of the objective existence range themselves in proper order (Bataille & Kendall, 2005).⁸

This awareness of the past, present and the possibility of a future are critical to our understanding of time and its passing. The existence of ancient sculptures is tangible physical evidence of the past and they also allow us to imagine the future because they inhabit an extensive time span. As Kubler observed in his book *The Shape of Time* the time frame that those objects exist in can extend far beyond the longest life span: "... artefacts do not possess a specific sort of duration, occupying time differently from the animal beings of biology and the natural materials of physics" (Kubler, 1962, p.83).⁹

For prized classical sculptures such as 'The Laocoon Group' (1st Century AD), made from hard marble and protected in galleries and museums, time stretches back to their creation and forward into the future. Some, such as Michelangelo's 'Pieta' (1498) are attacked and permanently altered. Others like the more contemporary 'The Bride Stripped Bare by Her Bachelors' (1915 to 1923) by Marcel Duchamp are broken and damaged whilst being moved. These changes are beyond the control of the artist. Over time sculptures are altered, diminished and restored, but the intention of the sculptor is that their form is static and unmoving. The sculpted army of Terracotta Warriors (210–209 BC) has remained unaltered, protected beneath the soil for over two thousand years. On a microscopic level there is always change. The surface has been attacked and patinated by chemicals in the soil but otherwise their form has remained constant.



Terracotta Warrior (210–209 BC)

Kubler creates a visual image of time and the way it is recorded:

Historical time ... is intermittent and variable. Every action is more intermittent than it is continuous, and the intervals between actions are infinitely variable in duration and content. The end of an action and its beginning are indeterminate. Clusters of actions here and there thin out or thicken sufficiently to allow us with some objectivity to mark beginnings and endings. Events and the intervals between them are the elements of the patterning of historical time (Kubler, 1962, p.83).¹⁰

'Atomised' was created in 2005, giving it a period of existence of 11 years. Within this time it has moments of activity when it is exhibited which punctuate long periods of inertia when it is unplugged from the power supply and kept in storage. These periods of activity within long spaces of inaction create, in Kubler's words, "clusters of actions" which "thin out and thicken". The lifespan of 'Atomised' is made up of a series of exhibitions which are dated and documented. When not exhibited the sculpture is static and does not function as a sculpture. As 'Atomised' is owned by Kinetica Museum my control over its ability to function as a working kinetic sculpture is reliant on it being exhibited and then how many hours in the day it is switched on for. Once it is exhibited, however, I am able to control how long it takes to respond to viewers, the length of time it takes for each component part to reach the centre, the duration that the whole figure remains in place and the same in reverse. Each section is individually timed using a Mitsubishi alpha 2 programme logic controller which was designed for use in industrial applications such as production lines.

When 'Atomised' is exhibited it remains static until the passive infrared sensor detects movement. The time when it is on or off is therefore triggered and dictated to by the arrival of people in the gallery. This is a random element which creates a sequence over which I also have no control.

'Atomised' has several different states depending whether it is static or actively triggered. It is either an incomplete unassembled sculpture, a complete assembled figurative sculpture, or a working moving sculpture which is in the process of either assembling or disassembling itself. The viewer is therefore able to experience the work in its static states and also experience the assembly as it happens. In this way they are able to witness the creation of the figurative sculpture much as it was created during construction only the time scale is compressed from weeks into minutes. It's a process which has been described by Eisenstein in relation to film: "The spectator not only sees the represented elements of the finished work, but also experiences the dynamic process of the emergence and assembly of the image (idea) just as it was experienced by the author" (Eisenstein, 1942, pp.3-68).¹¹

The change in state from static to moving and from disassembled to complete are the stages which mark the progression of the work through time. Work which is not visibly moving is not perceived in the same time scale as work which moves and alters its state. 'Atomised' is not just defined by its movement but also by its pauses and its moment of inaction when the figure is complete. These moments are arranged in order create a sequence. Arnheim (1954) described the way we perceive works of art as either

'simultaneous' or in 'sequence'. He distinguishes works of art which are performed, such as music and theatre, as a sequential progression. Arnheim argues that:

It has been asserted that painting and sculpture are as much 'time art' as music and the drama because the viewer must move with his eyes all over the surface of the work and therefore perceives its parts in succession. Actually, the order of a picture exists only in space, in simultaneity (Arnheim, 1954, p.376).¹²

Arnheim distinguishes between 'sequence' and 'mobility', emphasising the difference between the act of looking and a carefully coordinated sequential event. Kinetic sculpture, which alters its form and volume in space and time in a programmed sequence, however, must fall into the category of 'sequential'. This allows the work to be viewed and understood in a similar way that we perceive and understand time itself in terms of sequential events placed in order. 'Atomised' physically unfolding and assembling in sequenced steps, constructs itself in a linear visible timescale, altering its form and shape step by step. Its effect on the viewer is not just as a moving sculpture but as a sculpture which changes.

The idea of transformation in time is a more elementary and basic idea than that of movement. The term 'Transformation' or simply 'Change' comprehends the idea of movement, but includes also events in time where something different from movement is perceived (Benthall, 1972, p.104).¹³

It's the ability of the kinetic sculpture to alter its form and position in space and time which, combined with the movement, has an impact on the viewer. The pauses, and the movement in between, dictate the narration of the work and the way it is perceived by the audience. Jan Riley, curator of 'Mechanika', an exhibition of kinetic art at The Contemporary Arts Centre, Cincinnati, in 1991 described the process by which kinetic artists arrange their work in space and time from the viewer's point of view:

All of the work moves in a mechanical, almost hypnotic way. So that as you stand there you are trying to guess the next move in the sequence. And you're fascinated enough to try to figure it out. All the while the artist is delivering the subject matter (Riley, 1991, p.7).¹⁴

Here she recognises the role of the artists as the creators of a kind of performance. She asserts that each mechanical piece operates a series or sequence of events and that these events are arranged in this order by the artists. It's important to note that all the works to which she refers by artists such as Chris Burden and Rebecca Horn as well as installations by the group TODT are not puppeteered in real-time but operate independently under the artist's prior instruction. In order for moving sculpture to

operate either constantly or for predetermined periods there has to be some form of control. It's this central issue of control which I will look at next in the final chapter.

Chapter Three – Control

"...Control and choice ... are central to mainstream interactive arts" (Blackman, 1998, p.136)¹

The word control is taken from the French *contre-rolé* and referred to a form of accounting used by Venetian merchants in the fifteenth century. It has since become a widely used term to describe the exertion of influence over the outcome of events. The term may be relatively recent but the human need to control is a primal instinct. We have always sought to control our environment using tools, for example, to help us suppress weeds and ensure that the outcome of growth is in our favour and that the crops we want are the ones that survive. These instincts to control have continued to permeate all areas of life from family life to the stock market and the wider natural environment. In his book *Sensorium* Csikszentmihalyi describes the significance of control in a modern creative context in no uncertain terms: "Control may be one of the least noticed, most important concepts of contemporary culture, a significant crossover from technical language that permeates everyday life" (Csikszentmihalyi, 2006, p.125).²

In a similar way to Popper's division of movement into different categories, control in contemporary art can be separated into two distinct types. The first is the artist's control of the material and in kinetic sculpture this includes the control of movement, space and time. The second category of control is the artist's control over the audience and the ability of the artist to affect the way their work is perceived, experienced and understood.

Sculptors exert control over their materials using various tools and techniques, to make them do what they want, and to mould and shape them to their will. The sculptor Barbara Hepworth (1903–1975) described the process by which she carved as a balance of control and power between her hands:

My left hand is my thinking hand. The right is only a motor hand. This holds the hammer. The left hand, the thinking hand, must be relaxed, sensitive. The rhythms of thought pass through the fingers and grip of this hand into the stone (Hepworth, 1971).³

Stone sculptors exert control during the production of the work and when they finish carving the work is complete. Whether it is in storage or on display it is a finished sculpture. It can be viewed from different positions and at different times but neither the sculptor nor the viewer are able to alter or change either the form of the work or the way it is perceived. The sculpture, once finished, exists as discussed in the previous chapter, and remains this way until it is damaged or destroyed.

Mechanical or kinetic sculpture is by its nature different, as movement creates change in form, space and time.



Jean Tinguely, *Narva*, 1961

The early Mechanical sculptures were built by engineers and craftsmen who were truly masters of their materials. The works were constructed to a rigid plan, with an unchangeable outcome. Their aim was to delight and amaze their audiences. The earliest creative engineers such as Jacques de Vaucanson (1709–1782) and Robert Houdin (1805–1871) created sophisticated machines designed to emulate life. They were built with a set repertoire of movements which they would perform repeatedly without nuance or fluctuation, reflecting the skill and will of their maker. The work was carefully controlled and choreographed using a vast array of cogs, cams and pulleys. The extent of the movement and the potential of the sculpture to alter or change were planned during the design and construction stage and once decided and built, the sculptures behaved as intended by their maker. This remains true of contemporary kinetic sculpture but with the development of time-control devices such as the cam timer and later the digital timer, followed by programmable timers in the form of programme logic controllers there are increasingly more accurate options available to influence the eventual scope of movement, form and timing.



George Rickey, *Four Rectangles Oblique*, 1978

Some of the early pioneers of contemporary kinetic sculpture however, such as Tinguely and Calder, discarded this control and introduced chance and random interventions. Calder's finely balanced mobiles are moved by currents of air which keep them in constant motion and alter and change the form and structure of the work. George Rickey's (1907–2002) wind sculptures consist of very finely balanced stainless steel needles and rectangular plates which pivot on carefully designed concealed bearings. The scope and limitations of the movement of the arms is fixed during construction. Rickey designed them with freely pivoting joints which are able to move the needles and plates into multiple possible positions and as a result the sculptures don't follow a set pattern. Once installed he has no control over the movement of the needles which are triggered by even the most gentle breeze. The wind becomes an external controlling factor which influences the form and pattern of movement of the work. Calder and Rickey relinquish control of the overall form of their sculptures preferring an interaction with nature. The resulting structures are in a permanent state of flux with no fixed or permanent shape.



Conrad Shawcross, *The Steady States*, The Walker Gallery, Liverpool, 2005

In contrast, when Conrad Shawcross designed and built 'The Steady States' for The Walker Gallery in 2005, the constantly rotating illuminated arms were designed to run continuously. The length of the arms, the speed of the motors and the ultimate light patterns that the machine traced were set during construction and were unchangeable once installed. For a kinetic sculpture they are 'steady' indeed, creating patterns which are the result of decisions made during construction and without the intervention of external forces.



Rebecca Horn, *Concert for Anarchy*, 1990

Kinetic work which is programmable increases the ability of the artist to control the interaction with the audience. Rebecca Horn's 'Concert for Anarchy' (1990), for example, which consists of a suspended upturned grand piano, performs a set sequence of programmed events. Unsuspecting visitors are surprised by a sudden explosion of activity as the piano ejects its contents in a mass of wires and wooden acoustic hammers above their heads. The artist controls the performance of the sculpture, setting its timing so that the piece performs at predetermined times throughout the day.

The interactive sound sculpture 'Playground' installed at the Yorkshire Sculpture Park by Greyworld in 1999 has the added input of sensors which detect movement and respond to the presence of the audience. The result is an interaction between the audience and the installation as they jump, stamp and dance in an attempt to trigger the sounds.



Tim Lewis, *Pony*, 2008

At the most sophisticated level a kinetic sculpture can be programmed to 'behave' and 'respond', as with Tim Lewis's 'Pony' (2008), an ostrich-like creature made up of three articulated hands which walks and reacts to the presence of viewers via multiple sensors in its neck. 'Pony' has an added layer of interactivity as information passes from the artist to the sculpture to the audience and back to the sculpture. This allows the artist increased control over the interaction with the viewer whilst also losing control as the sculpture is able to behave in ways which are unpredictable and unforeseen.

Movement, whether under the complete control of the artist or not, has a compelling effect on the viewer. The innate response to moving visual stimulus, as outlined in the previous chapter, causes audiences to react to moving sculpture in a very direct way. Riley recognised the "immediacy and manipulative power of the work" (Riley, 1991, p.7)⁴ exhibited in 'Mechanika', the exhibition she curated in 1991. Although diverse in their types of movement and construction she stated that "...this body of work takes control" (Riley, 1991, p.7)⁵ and underlined the powerful nature of kinetic work to command the attention of the audience, saying: "These artists are ready. Their work is going to take you – whether you are ready or not" (Riley, 1991, p.7).⁶ It's clear that there is a level on which moving work has a visceral connection with the audience which can't be ignored. A point made clear by Riley when she describes the motivation of the artists in the exhibition is that "they want your attention. And they want your attention in a physical way" (Riley, 1991, p.8).⁷

As Duchamp pointed out there is a critical relationship between an artwork and the audience: "The creative act is not performed by the artist alone; the spectator brings the work in contact with the external world and thus adds his contribution to the creative act" (Duchamp, 1857).⁸

Nam Jun Paik decided to increase the creative participation of the audience by encouraging them to interact with his work. He was one of the first artists to experiment with technology such as televisions and tape recorders in a purely creative way and he became very interested in experimenting with the notion of handing an element of control of his artwork to the audience in order to achieve random compositions. In his first solo exhibition, 'Exposition of Music – Electronic Television', which took place at the

Galerie Parnass in 1963, Paik created a sound installation called 'Random Access' which consisted of audio tape stuck to the wall.



Nam Jun Paik, *Random Access – Schallplatten-Schaschlik*, 1963

Visitors were able to run hand-held tape heads over them to produce sound. A variation on this theme was 'Random Access' 'Schallplatten-Schaschlik:' which consisted of a vertical spindle with several 7-inch and 12-inch vinyl discs attached. They all rotated and once again the viewer was able to place a stereo needle at any point on any of the discs to create a random assortment of sounds.

More than almost any other work, 'Random Access' demonstrates Paik's avowed aim to disrupt the traditionally passive role of the recipient. The piece was meant to give the audience a freedom that was missing in conventional performance situations. As on a map, participants could determine musical positions and their temporal order, and thus become conductors of the events perceived (Ammer, 2009).⁹

By allowing them to intervene Nam Jun Paik facilitates the engagement of the audience, inviting them to become part of the creative process. By relinquishing control Paik empowers the audience.

Introducing the ability of the audience to control the output of a piece of work is now a standard approach for interactive installation. Some artists, though, have taken the idea of a separate controlling factor to affect the outcome of the work to unusual and creative extremes. In 1989, Paul De Marini, for example, created a kinetic sculpture called 'Edison effect' which relied on the movement of goldfish in a bowl to interrupt a laser and therefore control the output of sound which was being produced by a rotating Edison cylinder. Similarly, in 2008, David Shingler created 'Bird Drawing Machine' consisting of a rotating arm with a rubber wheel on the end and a pen which is able to move outwards from the centre via a delicate mechanism. At the centre of the structure is a birdcage containing two zebra finches and the whole assemblage sits on a large piece of paper. The machine works when the sound of the birds triggers the movement of the pen and a series of random drawings are created as the arm rotates.

For my sculptures, interaction with the audience comes in the form of passive infrared sensors which activate the work when someone approaches it. In this way the arrival of the audience begins the start of the mechanised performance. 'Blink', a wall-mounted glass eye, housed within a copper eyeball, is one of the most responsive. When a sensor is triggered the glass eye blinks. The sensor is, however, combined with a motor with a cam timer making the sequence random and impossible to predict. The result is that the viewer must stare at the eye and wait patiently for it to blink again. If they stand too still the passive infrared switches off, the motor stops, and the eye won't blink. In this way the viewer may wait patiently and because nothing happens, turn to walk away and miss the moment when the eye blinks with an audible snap. Alternatively there are times when the eye suddenly blinks causing the viewer to be surprised and shocked by the unexpected movement. The implementation of these elements in combination gives me a degree of control over the outcome but also allows for outcomes which are unplanned. Of all the pieces I have made, despite having no computerised control, 'Blink' is probably the sculpture which has the most control over the audience.



Jim Bond, *Blink*, 2008

In order to create a meaningful performance, speed and movement must be controlled. Control is essential to the kinetic sculptures I build. A rubber and a pencil are the moving elements of 'Eraser'. Each one is driven by a motor fitted with a microswitch. The switches send signals to the electronics so they know where the pencil is and where the rubber is. Without control there would be no spaces, no pauses in movement and therefore no performance. To do this I use motor speed controllers and programmable electronics so that the motors and mechanisms speed up and slow down depending on what they are required to do. The function of 'Eraser' is relatively simple. The two opposing machines sit on either side of an aluminium table. Each one embodies a clearly defined characteristic. On the right is a motor and mechanism which operates a thin, sprung, jointed arm holding the pencil. When approached by a viewer, the machine begins to operate and the pencil motor performs one revolution, driving the pencil forward across the paper, making a mark. It returns to its position and pauses. The

motor on the opposite side of the table which is equipped with the rubber then vigorously rubs the pencil line. The performance continues as one motor makes its mark and the other motor rubs it out. This is the dance of existence played out by machines in an endless game of construction and destruction using the simplest tools of the artist, paper, pencil and rubber.

In his book *Origins and Development of Kinetic Art* Frank Popper makes the distinction between work which does what the viewer expects and work which creates tension and surprise.

The main division ... is between foreseeable and unforeseeable movement. The classification may seem arbitrary, but from the point of view of the spectator it is most important. Does the spectator experience a *sensation* of predictability in his contemplation of the work in movement, or does he not? (Popper, 1968).¹⁰



Jim Bond, *Eraser*, 2014

In the case of 'Eraser' and the sculpture which preceded it, 'Dust', the machines are static until approached. As the form of these sculptures is clearly mechanical then it is foreseeable that they will move. What's unforeseeable, however, is the movement and actions that occur once they are in motion. The machines go through a cycle of actions. The first time it is observed by the audience it is a new performance which is unpredictable. The objects such as the eraser and the pencil, and in the case of 'Dust', the brush and the magnet, suggest functionality but it's not clear what shape the movement and the time sequence of the performance will take. It's critical that the machine has the ability to surprise and do something unexpected.

The narrative of 'Eraser' is all about the struggle to make our mark and the reality that time ultimately erases the traces we leave. The Swiss Automata maker Pierre Jaquet-Droz created a machine in 1772 which consisted of a boy writing at a desk. The animated boy writes 'I think therefore I am', mockingly quoting Descartes. 'Eraser' raises a similar point but one which has been stripped back to a starker and simpler message. Where Droz's machine playfully asserts its existence, 'Eraser' points to the ultimate futility of life. The carefully engineered script, painstakingly written across the page by the Automata boy is the result of hundreds of carefully engineered cogs and springs. The control mechanisms of this machine are the result of thousands of hours of hand-crafted

work. 'Eraser' dispenses with words, instead making a single pencil line and employs a fraction of the mechanical elements. A mass-produced electric motor controlled by electronics makes the mark and another one rubs it away. We make our mark and then we are gone. In his famous poem, the Persian poet and mathematician Omar Khayyam (1048–1141) wrote:

The Moving Finger writes; and, having writ,

Moves on: nor all thy Piety nor Wit,

Shall lure it back to cancel half a Line,

Nor all thy Tears wash out a Word of it (Khayyam, 1972, p.78).¹¹

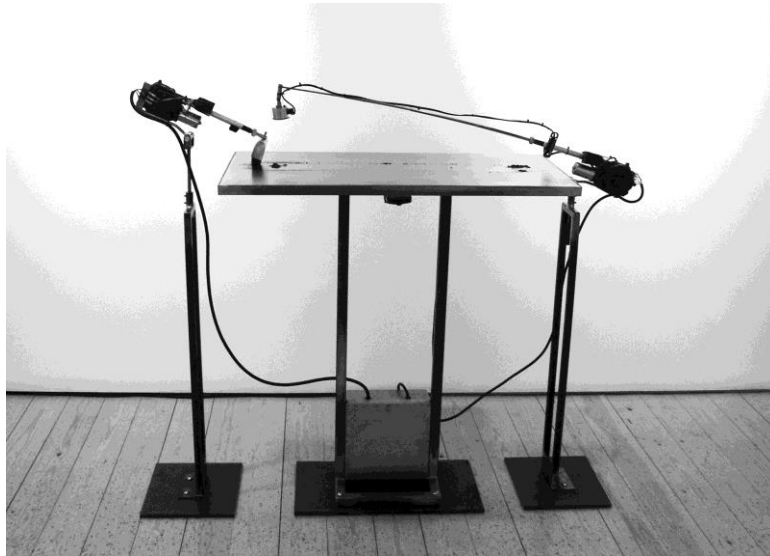
'Eraser' makes it clear that in the end the line will indeed be cancelled out and ultimately nothing will be remembered. The control of the speed gives the machines human qualities and characteristics. The slow deliberation of the pencil contrasts with the vigorous repetitive rubbing of the rubber. The time built into the sequence allows a moment of tension to exist between the first action and its opposing reaction.

The same qualities exist in the precursor to this machine, 'Dust', which was created for 'Domestic Appliance', an exhibition on a domestic theme at Flowers East, London, in 2007. This machine revisits the same subject matter of futility and the desire to exert control over our environment. The use of dust seemed an obvious one as it connects the micro and the macro representing as it does the annoying dirt that we can never get rid of as well as the matter of life itself, and the 'energy' referred to in Philip Pullman's *His Dark Materials*. The profound nature of dust is beautifully described by Denes in her *The Book of Dust* (1989):

Dust is the particulate matter, the dispersed, disordered raw material from which everything ordered and coherent arises, and it is to dust that the complex decays.

From the beginning to the end, dust underlies all existence...Everything that we understand as consistent, the living creature, the machine, the tree, are dust in its coherent phase, part of its continuous evolutionary cycle from order to disorder, from growth to decay repeated in seemingly endless variations (Denes, 1989).¹²

'Dust' the sculpture consists of two motorised mechanisms facing each other over a table. On one side an electro magnet picks up a pile of dust and carries it across the table where it drops it in front its opposing machine which is equipped with a brush. There is a pause. The brush then reacts and pushes the dust back across the table before withdrawing, leaving the pile of dust in front of the magnet.



Jim Bond, *Dust*, 2007

With this piece a never ending dance was played out between an electro magnet that attracted iron filings, quietly moved forward and then dropped them before its partner, a brush, opposite. The brush then, rather pointedly, swept the filings back over to the side of the table the magnet resided on. Like two siblings quietly tormenting each other (Barnes, 2008).¹³

For machines, though, there is no 'never-ending dance' as everything, including them, is finite or at least prone to wear and tear. When the machine breaks down the artist has lost control. Rebecca Horn accepts this as part of the qualities of the work:

My machines are not washing machines or cars. They have a human quality and they must change. They get nervous and must stop sometimes. If a machine stops, it doesn't mean it's broken. It's just tired. The tragic or melancholic aspect of machines is very important to me. I don't want them to run forever. It's part of their life that they stop and faint (Horn, 1993, p.27).¹⁴

Horn recognises that the breakdown is only a temporary moment of stasis in the life of the machine. By imbuing them with human characteristics Horn implies that "to err is human" (Pope, 1711)¹⁵ and that a machine that breaks down is fallible like a human being. By stating that she doesn't want her machines to run forever she makes it clear that the work is still valid if it doesn't move. For me, the movement is essential and without it the work is incomplete and doesn't function in the way that it was intended. Audiences who attended my recent exhibition, 'Machine Anatomy' at The Crossley Gallery, Dean Clough, Halifax wasted no time in telling me what wasn't working and it was clear from their concern that they regarded this as a failure.

It is one thing creating machines which work for a period and then break down. It's quite another if they never work at all. In 1999 the US artist Chris Burden created 'When Robots Rule: The Two Minute Airplane Factory' for the Tate Gallery, London. The idea conceived by Burden was for a machine to assemble and then launch a series of small rubber band aeroplanes which would fly through the gallery and then be available for purchase by visitors. The detailed design and fabrication was undertaken by the London design company Studio S. The machine was six metres long and consisted of a complex programmable production. Ultimately, however, the machine didn't work. No aeroplanes were produced and audiences and critics were left wondering if it was all a hoax perpetrated by an artist with a reputation for challenging and controversial work. It's impossible to know whether Burden intended for the machine not to work but I expect that the truth is that a machine with such a complex task, built on a tight deadline, with a limited budget, was bound to fail. The critical response, however, was that even in failure the machine had succeeded. Preece wrote in *World Sculpture Today*: "By not functioning, the work illustrated that robots, in fact, don't rule everything, and for the time being, are still subjected to individual and group shortcomings" (Preece, 1999, pp.70-71).¹⁶

Charles Darwent goes further, suggesting that failure may have always been the artist's intention as a subversive attempt to undermine the establishment.

Whether the whole thing was intended by Burden and/or the Tate Gallery, it doesn't really matter— its great art theatre. The issues of craft versus machinery, art as vernacular commodity, the friction of intention and interpretation, and the ambiguity of truthful representation have been ingeniously presented (Darwent, 1999).¹⁷

So the need for function and actual movement becomes irrelevant. The static machine tells the tale of Burden's ambitions. Only Burden can answer the question of whether this is what he planned to happen and whether he was actually in control or not.

Breakdown is an inevitable consequence of creating work which is intended to move. The machine is like a body with a limited life span which will inevitably end on the scrapheap. There are rare exceptions to this, such as 'The Silver Swan' designed and built by John Joseph Merlin in 1774 and still regularly performing its complex clockwork mechanical sequence at The Bowes Museum in County Durham thanks to careful ongoing expert maintenance. Most, however, if they survive at all, end up like Duchamp's 'Rotoreliefs' which were exhibited in 'Force Fields' at The Hayward Gallery in 2000, static and unmoving, too precious and fragile to be allowed to operate as they were designed to. Just as the fabled perpetual motion machine will always grind to a halt, so will the hopes of making machines which will run and function as designed forever.

In works such as *Eraser* or *Dust* Jim Bond engineers a serious satire on these ambitions: the dream that when we make a mark it might last forever turns out to be permanently defeated; the hope that when we clean up the world it will stay in

good order is always undermined by the return of something annoyingly chaotic (Schaffer, 2014).¹⁸

Control is always, ultimately, a temporary condition. The working order of machines will always succumb to chaos and entropy. In 1960 Jean Tinguely decided to short-circuit the process of gradual decay by building a machine which would last for one glorious performance, during which it would destroy itself. 'Homage to New York' was built from scrap in three weeks in the Buckminster Fuller Dome at the Museum of Modern Art, New York. The machine expanded rapidly as Tinguely scoured the Newark City Dump and built a series of random mechanisms such as a radio which would be sawn in half and a piano operated by arms attached to bicycle wheels. Billy Kluver, who assisted Tinguely with the project, described the control systems which were put in place to ensure that the machine functioned correctly and self-destructed.

Nothing was to be touched during the operation of the machine. The various functions and elements were started by pre-set time-delay relays. Everything was elaborately wired mechanically and electrically. All over the structure were smoke flashes and yellow smoke signals which would be started without direct interference. The combination of electrical and mechanical control gave Jean great freedom to develop his machine (Kluver, 1987, p.74).¹⁹

The performance itself, which was intended to be a kind of controlled chaos, famously descended into a Kafkaesque farce as a malfunction in the control system started a fire. Tinguely, concerned that there was a risk of the fire igniting a fire extinguisher on the back of the piano, signalled frantically to the fireman overseeing the event, demanding that he put it out. In a strange role reversal the fireman, having been given clear instructions to allow the structure to be destroyed, refused and the fire consumed the machine until eventually extinguishers were brought from the Museum and the fire was brought under control. It's no surprise that Tinguely's machine did not operate exactly as planned, having been rapidly constructed with no testing or checking of the mechanism and control systems. In this case the loss of control by the artist changed the direction of the performance, adding to the drama as the audience booed the firemen when they finally acted to end the performance despite this being done under the artist's instructions. Ultimately, despite the loss of control the machine did successfully destroy itself.

Control, then, can be tenuous with many variables. It could be argued that work which is on the brink of failure or has the potential for sudden and unforeseen change has more power to provoke a reaction and create excitement. This, however, is not always what the artist requires from a piece of work.

Conclusion

"What parts of the World do we have some control over? What parts are utterly beyond us?" (Kentridge, 2005, p.45).¹

As Kentridge (2005) states, there is always a limit to the extent to which we can control and order our environment and the things within it. Machines are the tools we use to help us do this by reducing labour, speeding things up and making life cheaper. It is in the nature of machines since their earliest incarnations that they can be controlled, switched on and off, speeded up and slowed down, and left to work for periods of time. Once artists started to work with machines, the control of speed and movement became available which led to an exciting new interactive medium. The use of sensors and programmable timers allow the control of time and actions to happen in a time sequence. Controllable motors and actuators created the ability for two-way communication between the artist and the viewer which was not previously possible. The potential for this was foreseen by the sculptor turned critic and writer Jack Burnham who curated the pioneering exhibition 'Software, Information Technology, its New Meaning for Art' at The Jewish Museum in New York in 1970. In the catalogue he predicted a new art "...that is transactional in that they deal with underlying structures of communication and energy exchange instead of abstract appearances" (Burnham, 1970).²

As I have established, the use of programmable technology can create the potential for a dialogue between the audience and the sculpture or installation. The information flows back and forth. In his essay *Transforming Mirrors: Subjectivity and Control in Interactive Media*, Rokeby (1995) describes this feedback as a kind of mirror: "Technology mirrors our desires; interactive technologies, in particular, reflect our desire to feel engaged" (Rokeby, 1995, p.158).³ Manovich (1996) goes further in his essay *On Totalitarian Interactivity*, suggesting that the ability to programme work gives the artist too much control of the audience and describes "...the phenomenon of interactive art and media as a shift from representation to manipulation" (Manovich, 1996).⁴

The question of whether control of the audience is benign or manipulative depends on the work and the perspective. Manovich admits that his view is coloured by his cultural background as a product of the Breznev-era Soviet Union. As Kluver (1967) states: "It is not a question of what the artist should do, but what he will do with technology. Whether technology is good or bad, threatening or friendly, beautiful or ugly is irrelevant" (Kluver, 1967, pp.11–12).⁵ Rebecca Horn's 'Concert for Anarchy', for example, may shock the viewer and this may be one of the intentions of the artist. Horn is provoking a reaction and this can be considered a manipulation but there is no malevolent intent. A painter can use imagery to shock which is another way of controlling the reaction of the viewer. The difference between a static painting and a kinetic sculpture such as Horn's suspended piano is the effect of the movement and sound on the senses. As Riley (1991) observed in her comments about the exhibits in 'Mechanika', the impact created by this happening in real-time engages the viewer in a way which provokes a response. As Arnheim stated, we are programmed to respond to movement in specific ways which demand our attention, engaging the senses of hearing and sight. The eyes pick up information which is rapidly altering and the effect on the viewer goes beyond the purely visual as the movement causes a physical response.

I have presented five of my kinetic sculptures as part of this discussion. They all consist of moving component parts which operate together to move into position and narrate a

story. There is a clear metaphorical structure in which the sculptures themselves are a stage set with the motors and electromagnets as actors playing out their role within the dramatic narrative. The experimental director Augusto Boal wrote that "theatre is the passionate combat of two human beings on a platform" (Boal, 1995).⁶ This is particularly pertinent to 'Dust' and 'Eraser' which both consist of two opposing 'players' engaged in 'combat' with the action taking place on a central 'platform'. This choreographed combination of sequenced movements has much in common with the human interactions presented on a stage. Laurel (1993) describes the Aristotelian view of theatrical narrative as essentially a series of actions:

The characters are there because they are required in order to represent the action, and not the other way around. An action is made up of incidents that are casually and structurally related to each other...The form of a play is manifest in the pattern created by the arrangement of incidents within the whole action (Laurel, 1993, p.65).⁷

Using programmable components I create 'patterns' and 'arrange incidents'. For my work and the work of many kinetic and installation artists such as William Kentridge there is a play within a play. There is the work itself which is manipulated by the artist using controls, sensors and mechanisms and then there is the audience who are external to this action but observers of it.



Jim Bond, *Atomised*, Crossley Gallery, Dean Clough, Halifax, 2014

My aim is to provoke a reaction from these viewers. Their responses are harder to plan and not always possible to control. The audience is free to wander and explore the work from all sides, making an experience which is distinctly different from a theatrical environment where, traditionally, the entertainment is presented to them. Not all

audiences are allowed to wander, however, or even to watch from the comfort of a theatre seat. James Turrell's immersive light installation 'Bindu Shards', for example, didn't allow the audience the luxury of freedom. Exhibited at the Gagosian Gallery in London in 2010 the installation requires the audience to individually lie on a bed similar to those used for an MRI scanner. Once they are horizontal they are slid into the sensory dome on their backs by white-coated technicians. They are then bombarded by an intense sequence of changing light. Will Gompertz described the experience:

Within 30 seconds Turrell has you tripping the light fantastic. The sensation is decidedly odd. It feels as if some child has got hold of each of your eyeballs in their sticky fingers and is twisting them to-and-fro like a kaleidoscope. You are totally engulfed in fractured images of bright colours; creating a wholly disorientating and oppressive atmosphere (Gompertz, 2010).⁸

Turrell's intention is not to disturb the audience. In fact it is quite the opposite as he states he wants to enlighten them so that they can share his vision and literally see the light.

"My desire is to set up a situation to which I can take you and let you see. I am interested in light because of my interest in our spiritual nature and the things that empower us. My art deals with light itself, not as the bearer of revelation, but as revelation itself" (Turrell, 2010).⁹

The effect Gompertz experienced, however, is less revelatory and empowering and more 'oppressive' and disempowering. It could be argued that Turrell, in his bid to create a totally immersive experience, has taken too much control, leaving his audience feeling vulnerable. This is one extreme example of the artist's ability to control an audience who are willing to place themselves in a position in which they allow this to happen. They have chosen to enter the space and place themselves in that environment.

There is a fine line to tread between control and manipulation and, as I have illustrated, interactive kinetic installation can range from the passively engaging visual spectacle of an Alexander Calder to the physical intensity of this Turrell. The two-way dialogue between the work and the audience becomes a triangle of interacting elements. A flow of information and control passes from the artist to the machine which acts as a conduit. The artist controls the machine and therefore controls the experience of the audience. The audience operates the machine by their proximity to it and interaction with it. Without their presence the machine is lifeless waiting to perform, like an empty theatre. When the audience arrives the show begins. The artist has the choice to voluntarily hand over control to the audience or allow random elements to exert influence over the outcome of their work. The kinetic works are also always open to the possibility of faults, component failure and breakdown which alters their ability to function. As Hans Haacke

stated in his 1967 interview with Jack Burnham: "The mere fact that it moves has no value in itself".⁹ What makes kinetic sculpture so interesting to the audience is this relationship between them, the work, and the artist and the potential for the work to change its speed and position in space and time depending on the balance of these elements of control.

Ultimately, this endless struggle for control over the work and influence over the audience is a microcosm of the bigger struggle for existence itself. The human desire to create order out of disorder and sense out of chaos, as Simon Schaffer pointed out, is only ever a temporary illusion. The mechanical parts of a moving sculpture will wear and the electronic controls will suffer from component failure. The artist's attempt to elicit a specific reaction from the audience is also prone to unpredictability as people come to a piece of work with their own experiences and understandings and their own agendas. It remains true, however, that to a greater or lesser extent the kinetic sculptor is able to exert control over both the work and the audience by creating work which changes and alters its form in response to a combination of programmed instructions, sensor triggers, and audience interaction.

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